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COOKED UNEXTRACTED SOYBEAN MEAL

ITS ECONOMIC FEASIBILITY IN POULTRY FEEDS

Marketing Economics Division

Economic Research Service

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SUMMARY

In poultry feeding tests beneficial results have been obtained by a change in materials used. Cooked unextracted soybean meal can be used in place of soybean meal and an added "inedible" fat. This finding opens the way to direct conversion of soybeans to feed mixing uses by feed mills or other feed ingredient processors.

Case studies of poultry feeds made by five feed mills in the northwest Arkansas poultry area show that, in the last 3 months of 1960, cooked unextracted soybean meal was commercially acceptable and economically justified. Potential cost savings, exclusive of processing costs for making cooked unextracted meal ranged from $2.76 to $13.62 per ton of soybeans. The savings would have been available to cover costs such as flaking, cooking, and drying of whole meal plus profits to the processor. Most feeds made in these five mills offered potential returns well above the lowest level of $2.76 per ton.

Fat that is added to feed was the ingredient considered to be wholly replaceable by the oil in unextracted soybean meal in each case. The protein in cooked unextracted meal substitutes for a like quantity of protein from soybean meal in the feed mix. Feed mixes studied ranged from 1 percent to 5 percent of added fat.

Cooked unextracted soybean meal also offers advantages to the feed mixer which are not directly related to the prices and energy values of ingredients:

(1) It is a granular material that can be handled at lower cost than a high-melting-point fat in the feed mixing operation.

(2) Having the fat within the matrix of the feed particle rather than sprayed on its surface may permit higher fat content feeds to be made into satisfactory pellets.

(3) Quality of the fat in unextracted soybean meal is higher than that of fat obtained from most other sources.

(4) A feed mill that buys locally grown soybeans in the fall for later use would protect itself against rising prices of protein meals later in the year. In 3 of every 5 years, such an action would have been an economic advantage to the feed mill.

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COOKED, UNEXTRACTED SOYBEAN MEAL, ITS ECONOMIC FEASIBILITY IN POULTRY FEEDS
(Preliminary Report)

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INTRODUCTION AND BACKGROUND

Feeding tests with poultry have shown that beneficial results can be obtained by an ingredient change in mixed feeds. In place of soybean oil meal and an added "inedible" fat in the ration, cooked unextracted soybean meal can be used. This finding opens the door for consideration of direct conversion of soybeans to feed mixing uses by feed mills or other feed processors. Economic questions of feasibility of processing soybeans this new way need to be resolved. A feed mixer or other processor of cooked unextracted soybean meal needs the means of deciding which is cheaper, tallow or grease added to a feed mix with soybean meal, or soybeans plus the cost of processing them this new way.

This study was made to obtain preliminary evaluations of the various factors influencing this economic decision. A satisfactory commercial process for producing cooked unextracted soybean meal has not been completely worked out. Equipment manufacturers need to design equipment with processing costs per unit within the potential margins allowable.

Economic research is needed to bridge the gap between nutrition research findings on cooked unextracted soybean meal as a poultry feed ingredient and commercial adoption of the product. Possible users of such new equipment need a guide as to the potential for profit it offers.

This analysis was made in the fall of 1960. The price of soybeans and of soybean oil rose early in 1961, making the potential return from using soybeans as unextracted meal less attractive. This analysis can serve as a guide in making decisions in the future when soybeans are competitive again with soybean meal plus added fat as a direct feed ingredient.

This report is a summary of the findings from a series of case studies of individual feed mills in the northwest Arkansas poultry growing area. Also included is a preliminary economic analysis of the Delmarva poultry area, derived from published sources. Further studies in Delmarva and other poultry areas are planned to explore the possibility of using cooked whole soybeans in mixed feeds.

Study was made specifically in the poultry industry because of several factors: (1) The industry is the major user of added fats as well as soybean meal in feeds. (2) High efficiency rations (high protein-high fat) are used

more often for poultry than for other types of livestock. (3) The poultry industry is highly competitive--economy and efficiency conscious. (4) Most areas of concentrated poultry production are in States where soybean production is expanding most rapidly.

Production of soybeans in 1960 in the United States is estimated at 559 million bushels. Projected volume for the 1961 crop is 725 million bushels. The United States now is the world's largest soybean producer, raising over 50 percent of the world's crop. Further increases in soybean production are predicted for the future.

There are several reasons for expecting an increase in production: (1) Soybeans fit well into most farm programs. (2) They can be grown and harvested by machinery with little labor. (3) New varieties will increase yields and widen production areas. (4) Prices of soybeans have been high enough in most years for farmers to make a profit growing them. (5) Rising standards of living in most parts of the world mean an increase in the demand for edible vegetable oil and protein, for which soybeans are the most promising source.

The price of soybeans, like that of other large-volume food crops, has declined in recent years. The highest seasonal average price received by farmers was $3.33 per bushel in 1947-48. This was followed by a gradual decline in prices through 1957-58. Since then the price has been stable at about $2 per bushel.

The price of soybean oil, on an annual average basis, has varied from 17.8 to 8.3 cents a pound in the last 10 years (this is crude soybean oil in tank-car lots, f.o.b. Decatur, Ill.). Average prices for the last 3 crop years were 10.8 cents a pound for 1957-58, 9.5 cents for 1958-59, and 8.3 cents for 1959-60 (table 1). It used to be that demand for soybean oil determined volume of soybeans to be processed and time they were processed; but now soybeans are processed when there is a need for meal. Oil is no longer the highest value product obtained from soybeans. In the last 3 years extracted oil has accouted for only 44 percent of the total value of processed soybeans, meal has amounted to 56 percent. This is true despite a drop in meal prices from 4.17 cents per pound in 1951 to 2.37 cents in 1956. Since 1956, meal prices have increased somewhat, averaging 2.79 cents per pound in 1958 and 2.78 cents per pound in 1959.

Use of added fats in feeds began in a major way in 1953. Since 1957 about one-half billion pounds of "inedible" fats have been consumed annually in mixed feeds. Tallow and grease, the two major types of "inedible" fats used in feed are always lower priced than soybean oil. In recent years the margin of price difference has decreased sufficiently to merit evaluation of leaving soybean oil in the meal for feed purposes.

Addition of fats to feed presents a problem. 1/ To handle fats, feed mixers need to have storage facilities for liquids, and heating equipment to

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1/ Doty, H. O. Jr. Fats Added to Feeds--An Economic Analysis. U. S. Dept. Agr., Econ. Res. Serv. Mktg. Res. Rpt. 498. Sept. 1961

liquify solid or hard fats as well as piping, measuring, pumping, and spraying equipment. Cost of this equipment is prohibitive for small and medium size plants. A dry or granular high-fat-content ingredient is needed to circumvent these large capital requirements for making feeds with high energy content.

Feed manufacturers must be very careful of the quality of fats used. They are not a market for all excess supplies of soap-stock type fats. Sources of better quality fat materials are being sought by many feed manufacturers. Unextracted soybean meal made under quality controlled conditions may be the answer to many of the problems now faced in making high energy feeds with added "inedible" fats.

In the past raw soybeans have been used at times in livestock feeds, particularly for cattle and sheep. Digestion efficiency of raw soybeans by livestock is poorer than for equivalent soybean meal. Nutritionists found out that the heat-labile, antinutritional factors in uncooked beans are the cause. Whole soybeans, properly heat treated, have been shown to give a growth response equal to or better than reconstituted soybeans (soybean oil plus meal).

In recent years, production of soybeans has greatly expanded in States of the South and Middle Atlantic regions. As a result, soybeans are now readily available locally in many feed consuming areas at substantial savings in freight and handling charges over soybean meal and rendered fat from midwestern processors or price-basing points.

Other factors in favor of leaving soybean oil in the meal are: (1) The rather large amount of caloric value (feed energy) that the oil contains over that in feed-grade fats. Soybean oil offers a reported 4,172 calories of metabolizable energy per pound compared with 3,230 per pound for feed grade tallow. 2/ Soybean oil offers 29.2 percent more calories per pound than feed grade fat; it takes approximately 9 cents worth of 7-cent-a-pound-feed-grade tallow to equal a pound of soybean oil in feed value. (2) Soybean oil left in the meal is more constant in energy value than feed-grade fats offered to feed mixers. (3) Most of the oil is in the matrix of the feed particle rather than being sprayed on the outer surface as the case with added fats.

For optimum dust control and physical appearance benefits in mash type feeds, most feed manufacturers say 1 to 3 percent fat (depending on formula and grind) should be added to the total feed mixture. For high efficiency type feed formulations, such as most broiler feeds now in use, the level of added fat may range up to 10 percent, depending on the source, type and level of protein used.

2/ Renner, Ruth and Hill, F. W. Metabolizable Energy Values of Fats and Fatty Acids for Chickens. Feedstuffs, Vol. 30 (46), Nov. 15, 1958, p. 15.
The Journal of Nutrition. Studies of the Effect of Heat Treatment on the Metabolizable Energy Value of Soybeans and Extracted Soybean Flakes for the Chick. Vol. 70 (2) Feb. 1960, p. 219.

Nutrient Value of Whole Soybeans

The dollar value of products from solvent extraction of 100 pounds of soybeans is given in table 2. These values were calculated by using the U.S. 1952-1959 average soybean crushing yield of 78.3 percent of 44 percent protein meal, 18.3 percent crude oil and 3.4 percent loss in moisture and waste.

Table 3 gives the dollar value of a cooked unextracted meal product from 100 pounds of soybeans by calculating the "make up" cost for it using feed-grade fat. Oil value was determined by multiplying the U.S. average yield of 18.3 pounds of oil per 100 pounds of beans by each price then multiplying by 1.292 to account for the difference in caloric value between soybean oil and feed-grade fat. Soybean meal protein values were the same in tables 2 and 3, since the quantity of protein obtained is the same from 100 pounds of soybeans, whether oil is extracted or not. Table 4 shows a series of comparisons in the relative values of unextracted soybean meal (from table 3) and of oilseed meal and extracted oil from 100 pounds of soybeans (from table 2).

Economic Effects of Other Factors Than Nutrient Differences

Figure 1 shows the effects of various factors governing the economics of using cooked unextracted soybean meal. The equal cost line reflects the 29.2

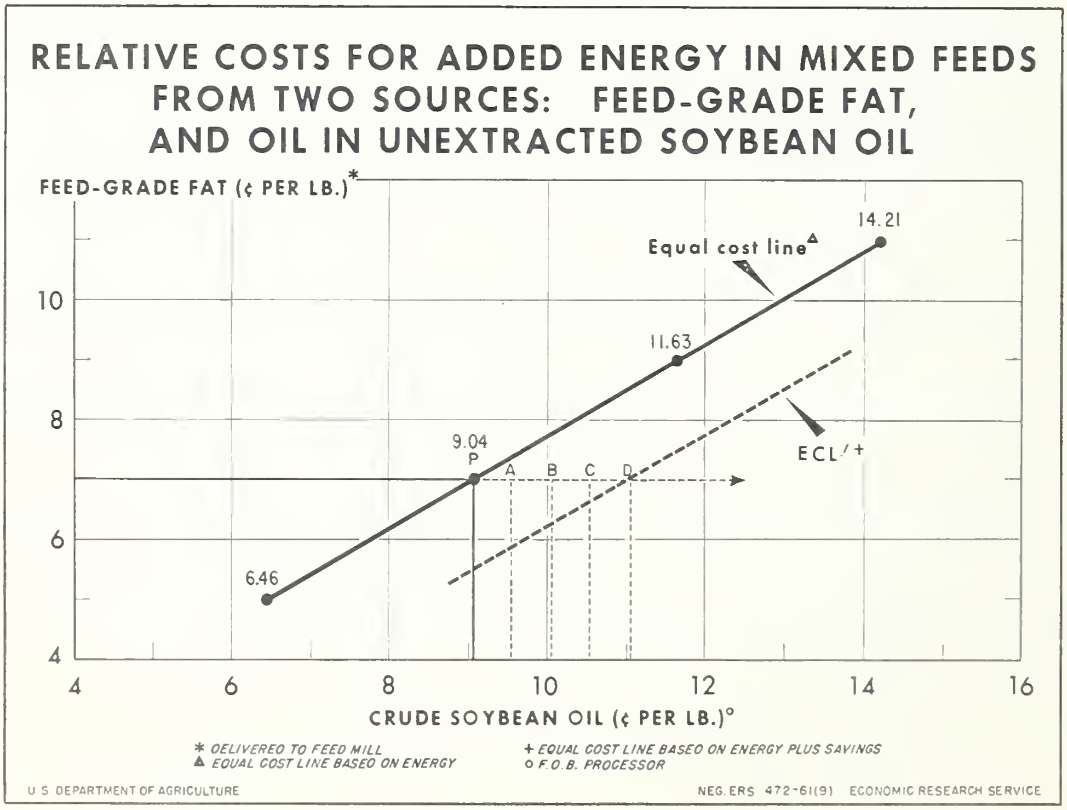

Figure 1

percent higher energy yield of crude soybean oil in terms of equivalent prices for energy. At point P in figure 1, soybean oil and feed grade fat are equal in energy cost. At this point feed grade fat is 7 cents a pound and soybean oil is 9.04 cents a pound. For any given price of feed grade fat, reading across to the line of equal cost and then down will give the price of soybean oil that is equal in energy cost.

Points A, B, C, and D are shown as 1/2-cent increments from point P. They represent effects of various savings through use of cooked unextracted soybean meal by the feed mill. Savings in freight costs of meal, costs of handling, storing, heating, and mixing a feed-grade fat, and prices paid for locally grown soybeans are economic factors which can shift the equal cost line to the right to points A, B, C, D, or further. Under these conditions, costs would still be equal although there is an increased price spread between feed grade fat and crude soybean oil.

Local feed mixers' operating conditions can make even wider spreads possible. For example, freight charges on a 50 percent protein soybean meal of $10 per ton is equal to 1 cent per pound freight on soybean protein. If local soybeans are the source of protein, through unextracted soybean meal, this charge for freight on protein can be applied to the soybean oil versus feed-grade fat price spread and to the margin needed for processing the unextracted meal. (There is approximately one pound of protein and 0.48 pounds of oil in 2.6 pounds of soybeans.) This savings on freight, when applied as a saving to the oil, amounts to about 2 cents a pound. This saving would shift the equal cost line to the right slightly beyond point D (line ECL'). Soybean oil, in unextracted meal, at about 11 cents a pound would now be equal in cost, from the feed mixers' viewpoint, to feed-grade fat at 7 cents a pound.

Economies of Dry versus Liquid Fats in Feed Mixing

A granular ingredient with high-fat-content would lower costs for storing, handling, heating, metering, and mixing liquid or semisolid fats by the feed mill. No data on actual costs are available but feed mills of small or medium capacity not now using fats have indicated to trade sources that they would pay a premium of 2 cents or more a pound for a dry fat. Cooked, unextracted soybean meal offers such a capability. Study of individual feed formulations and ingredient costs can provide necessary data for determining the feasibility of making and using cooked unextracted soybean meal.

Whenever the cost of feed-grade fat is within 4 cents of the current market price of crude soybean oil, the feed mixers should investigate to see if it is profitable to use cooked unextracted soybeans rather than feed-grade fat with soybean meal.

Cost of Processing

Information is not available on the prospective cost of commercial processing of cooked unextracted soybean meal. It is estimated that the U. S.

average cost of solvent extraction of oil from 100 pounds of soybeans is 40 cents. 3/ In the processing of unextracted meal there would be no oil extraction. Therefore, the investment in plant and equipment, per bushel of beans processed, would be considerably less. Labor and other variable costs are estimated to be more than 25 percent less. 3/ Thus, the difference in variable and fixed processing costs of making unextracted soybean meal versus making oil and meal would be more than 1/10 of a cent per pound, in favor of making unextracted meal. When crude soybean oil prices are 9 cents per pound and feed grade fat prices are 7 cents per pound, the difference in caloric value alone is approximately equal to this 2 cents per pound difference in price.

The actual price difference per pound between crude soybean oil and prime tallow at midwestern price-basing points has averaged 2.8 cents over the past 3 years (table 1). The caloric difference of 2 cents per pound and estimated variable processing cost differences of 0.1 cents per pound gives 2.1 cents per pound gain in value of soybean oil over feed-grade fat for feeding purposes. Then, the difference in value of oil in present market uses against its value in feed becomes on the average only 7/10 or less of a cent a pound, on the basis of prices in these 3 years.

For these reasons, analysis of local situations for potential use of locally grown soybeans, through local processing and feed mixing facilities, will show many opportunities where this 7/10 cent per pound disadvantage will be overcome and a true economic advantage can be had for making and using unextracted soybeans in the area.

A close approximation of the margin for processing soybeans into cooked unextracted meal may be made by adding the cost of 473 pounds of feed-grade fat plus the cost of 760 pounds of protein in currently used rations and subtracting the cost of a ton of locally grown soybeans (18.3 percent fat and 38 percent protein in whole soybeans). For example:

473 pounds of feed-grade fat @ 6 cents per pound = $28.38
44 percent (protein) soybean meal @ $54.00 per ton or 2.7 cents per pound (= 2.27 x 2.7) = 6.13 cents x 760 = $46.59 (value of protein in a ton of soybeans)
Local soybeans @ $2.00 per bushel = $66.67 per ton.

$28.38 + $46.59 — $66.67 = $8.30 margin for processing a ton of beans to cooked, unextracted meal.

Feed Mill Case Studies in Northwest Arkansas

A series of case studies were made, in May of 1961, in feed mills in northwest Arkansas. Six counties 4/ in this area produced about 120 million broilers

3/ Brewster, J. M. and Mitchell, J. A. Size of Soybean Oil Mills and Returns to Growers. U.S. Dept. Agr., Mktg. Res. Rpt. 121, Nov. 1956.

4/ Washington, Benton, Madison, Carroll, Pope, and Yell Counties.

in 1960. This area has been a leader in growth of production among various major broiler areas for the past several years. Here, there is a highly integrated broiler production industry with the dozen or more feed mill operations as focal points of financial and management control for breeding, chick production, broiler feeding, slaughtering, processing, and marketing.

In five of these feed mills, the costs and volumes of protein and energy ingredients of feeds used during October, November, and December 1960, were obtained in detail from company records. A cost comparison was made between these currently used ingredients and a hypothetical ration using whole unextracted soybean meal, observing that locally grown 5/ soybeans could have been obtained for processing at $1.90 per bushel. In every case, regardless of the rate of substitution or materials substituted, there was an economic gain potential for using whole soybeans. This gain was indicated only from purchase prices of ingredients used. In several of these mills, the costs for handling and using feed-grade fats were suggested as a major additional economic factor, but these costs were not observed in sufficient detail to be included.

Feed manufacturers in the area have considerable knowledge of, and some have even experimented with, cooked unextracted soybean meals. A firm in the area has made and fed such a product for 2 years. Also, the University of Arkansas has conducted some experimental work with meals of this type. This prior knowledge made consideration of likely substitution rates, of differences in energy values, and other factors necessary in the substitution calculations easy for the feed mixers to understand.

Freight rates on soybean meal to mills in the area range from $2.00 to $9.50 per ton, depending on source of meal and location of the feed mill. Freight rate differentials were partially compensated for by different prices for soybean meal (50 percent protein basis), tending to "level" the cost for meal in the whole area. Since savings in freight is a major factor in the economic justification for using whole unextracted soybean meal, these differentials in freight cost did cause the individual mills studied to have a wider range of potential gain from using unextracted meal made from locally supplied beans than was expected.

At least five types of added fat were used. These were: a commercial type feed-grade animal fat from local renderers, "inedible" tallow of various grades, poultry oil from local poultry byproducts rendering operations, off color rice oil, and a hydrolyzed animal fat and vegetable oil mixture. All prices of added fats used were in cents per pound, delivered basis, and did not include the costs of heating, storage, and handling of fats or oils in the feed mixers' plant. Most firms indicated they would use a whole soybean meal to substitute for only a part of the 50 percent protein soybean meal now used. That is, they would apply it as an ingredient to obtain the same caloric value from the oil as they obtained from added fats used (ranging from 1 percent to 5 percent of added fat), and they would reduce the 50 percent protein soybean meal volume equivalent to the amount of protein obtained from the whole soybean meal. Among the five mills, the amount of whole soybean meal needed would range

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5/ Grown in Arkansas, Kansas, Missouri, and Oklahoma, within a 100 mile radius of the poultry area.

from the equivalent of 1.4 to 7.2 bushels of soybeans, as unextracted meal, per ton of feed made. The difference in quantities of soybeans needed is caused by variations in the percentage of fat added and caloric value differences between the various fats used.

If whole soybean meal were substituted for all the soybean meal, the resultant feed made would have much higher caloric value than feeds now made, and the nutritionists indicated they would need more knowledge of the feed benefits and economics of the new mixture before they would use this higher level of fat.

For those feeds in which unextracted soybean meal was considered as a calorie-for-calorie substitute for added fats, differences in the costs for ingredients now used and costs for raw soybeans to replace them ranged from 26 cents to $1.76 per ton of feed made. Converting these cost-saving potentials per ton of feed to a per bushel of soybeans basis, these feeds could have been made from locally grown soybeans with potential processing allowances from 8.3 to 40.9 cents per bushel for making unextracted soybean meal. This then, is a range of from $2.76 to $13.62 per ton of soybeans. The range of values is mostly due to comparing unextracted meal in a ration now containing a high caloric value vegetable oil, obtained at feed-grade fat cost, to other rations made with a lower energy feed-grade fat: and at various shipping costs per ton for soybean meal.

The study of individual feed mills and ration costs in the northwest Arkansas area indicates the need for individual firms to study in detail the economics of using locally grown soybeans as a feed mixing material. Most of those visited in relation to the study viewed the proposition as a distinct probability for the future. They felt that research is now needed to guide tnem in selecting processing techniques, handling methods, quality control and financing relative to the operations of such a facility.

It is interesting, if perhaps academic, to calculate what influence the use of cooked unextracted soybean meal would have had, had it been used in 1960 in northwest Arkansas for the broiler industry. Producing 120 million broilers at 3 pounds live weight at 2.4 pounds of feed per pound of broiler takes 432 thousand tons of feed. At 4.3 bushels of soybeans per ton of feed in the form of unextracted meal, 1.86 million bushels of soybeans could have been consumed in northwest Arkansas. This is equal to about 1/3 of the total soybean production in a 100 mile radius of the major poultry growing area of Arkansas in 1960.

No evaluation has been made of the influence this amount of soybean consumption would have on price or production. Feed mills would create a new market for soybean oil and would expand the overall consumption. However, because soybean meal and cooked unextracted soybean meal are interchangeable sources of protein, use of unextracted meal would not be an expansion of feed mixers' soybean protein demand.

In the discussions with the five feed mill operators in Arkansas, and others who have experimented with cooked unextracted soybean meal, we found that the product also offers potential advantages other than price and energy

cost considerations as a feed ingredient. Advantages that were pointed out were:

(1) It is a granular material that can be handled at lower cost than a high-melting-point fat in the feed mixing operation.

(2) Having the fat within the matrix of the feed particle, rather than sprayed on its surface may permit higher fat content feeds to be made into satisfactory pellets.

(3) Quality of fat is higher than that obtained from most sources of added fat.

(4) A feed mill that acquired locally grown soybeans in the fall, for later processing and use in feed could use them as a protection against rising prices later in the year. Holding the beans in storage would allow the feed mixer to either make cooked unextracted meal or sell soybeans and buy meal and feed-grade fat, which ever proved advantageous. Feed mixers said that in 3 of every 5 years, such an action would have been an economic advantage. The futures markets, in soybeans or in soybean meal, could also be used for additional protection (and for a source of financing stored soybeans).

The broiler industry is the largest user of both soybean meal and feeds with added fats. Table 5 shows the demand for protein meal for broiler feeds in the major broiler production areas (excluding Arkansas) and the production of soybeans in these areas in 1958. Two of the major producing areas, Georgia and Delmarva, produce soybeans equivalent to their needs for broiler feeds. However, a substantial amount of protein concentrate would be needed for other livestock fed in these areas. About 4/5 of the soybeans produced in Delmarva go into foreign trade. Feed manufacturers in Delmarva pay from $17.00 to $21.70 freight (according to shipping and delivery point) on soybean meal (see table 6). Soybean prices paid to farmers in Delmarva are somewhat lower than national average prices paid (13 cents a bushel lower in 1958).

Using secondary data and a spot check on materials costs in the area, an economic analysis of the potential processors margin for making cooked unextracted soybean meal at mid-January 1961 delivered prices of feed ingredients in Delmarva was determined:

	January 1961 prices
Soybeans........................	$ 1.98 per bushel or $3.30 per 100 pounds
44 percent soybean meal..........	70.00 per ton, including freight
Feed-grade fat...................	0.06 per pound
Crude soybean oil................	0.104 per pound

Soybean prices to the processor would be $3.30 per 100 pounds. The equivalent of 100 pounds of cooked unextracted soybean meal at the prevailing prices of feed-grade fat and soybean meal was $4.16 per 100 pounds. The potential margin for unextracted soybean meal processing, therefore, would be $4.16 — $3.30 or $0.86 per 100 pounds of beans processed.

In this area, therefore, an economic situation existed whereby potential local soybean processors could buy local farmers' soybeans at competitive prices, make cooked unextracted soybean meal, and use it for feed mixing with a gross operating margin of $17.20 per ton of soybeans processed.

Table 1.--Average price per pound in tank car lots of crude soybean oil f.o.b. Decatur and prime tallow f.o.b. Chicago, by months, Oct. 1957 - Sept. 1960

Month	1957-1958			1958-1959			1959-1960		
	Soybean oil	Tallow	Difference	Soybean oil	Tallow	Difference	Soybean oil	Tallow	Difference
	Cents	Cents	Cents	Cents	Cents	Cents	Cents	Cents	Cents
October	11.3	8.0	3.3	10.2	7.6	2.6	8.6	6.1	2.5
November	11.6	8.0	3.6	10.4	7.6	2.8	8.0	5.9	2.1
December	11.4	7.9	3.5	9.5	7.2	2.3	7.8	5.6	2.2
January	11.5	7.6	3.9	9.5	7.1	2.4	7.8	5.2	2.6
February	11.5	7.5	3.0	9.3	6.8	2.5	7.6	5.3	2.3
March	11.0	7.8	3.2	9.3	7.0	2.3	7.6	5.6	2.0
April	11.0	7.4	3.6	9.3	6.9	2.4	8.0	5.9	2.1
May	11.0	7.3	3.7	9.4	6.9	2.5	8.2	5.7	2.5
June	10.2	7.5	2.7	9.5	6.6	2.9	8.7	5.4	3.3
July	9.9	7.6	2.3	9.2	6.4	2.8	9.0	5.4	3.6
August	10.0	7.6	2.4	9.3	6.1	3.2	9.5	5.6	3.9
September	9.8	7.4	2.4	9.1	6.3	2.8	9.2	5.5	3.7
Average	10.8	7.6	3.1	9.5	6.9	2.6	8.3	5.6	2.7

Table 2.--Combined value of meal and oil extracted by the solvent method from 100 pounds of soybeans, at specified prices of oil and meal 1/

Price of 44-percent soybean meal, per pound	Price of crude oil, per pound--												
	5 cents	6 cents	7 cents	8 cents	9 cents	10 cents	11 cents	12 cents	13 cents	14 cents	15 cents	16 cents	17 cents
1.50 cents...	$2.09	$2.27	$2.45	$2.63	$2.82	$3.00	$3.18	$3.37	$3.55	$3.73	$3.91	$4.10	$4.28
1.75 cents...	2.29	2.47	2.65	2.83	3.02	3.20	3.38	3.57	3.75	3.93	4.11	4.30	4.48
2.00 cents...	2.49	2.67	2.85	3.03	3.22	3.40	3.58	3.77	3.95	4.13	4.31	4.50	4.68
2.25 cents...	2.68	2.86	3.04	3.22	3.41	3.59	3.77	3.96	4.14	4.32	4.50	4.69	4.87
2.50 cents...	2.88	3.06	3.24	3.42	3.61	3.79	3.97	4.16	4.34	4.52	4.70	4.89	5.07
2.75 cents...	3.07	3.25	3.43	3.61	3.80	3.98	4.16	4.35	4.53	4.71	4.89	5.08	5.26
3.00 cents...	3.27	3.45	3.63	3.81	4.00	4.18	4.36	4.55	4.73	4.91	5.09	5.28	5.46
3.25 cents...	3.46	3.64	3.82	4.00	4.19	4.37	4.55	4.74	4.92	5.10	5.28	5.47	5.65
3.50 cents...	3.66	3.84	4.02	4.20	4.39	4.57	4.75	4.94	5.12	5.30	5.48	5.67	5.85
3.75 cents...	3.86	4.04	4.22	4.40	4.59	4.77	4.95	5.14	5.32	5.50	5.68	5.87	6.05
4.00 cents...	4.05	4.23	4.41	4.59	4.78	4.96	5.14	5.33	5.51	5.69	5.87	6.06	6.24
4.25 cents...	4.25	4.43	4.61	4.79	4.98	5.16	5.34	5.53	5.71	5.89	6.07	6.26	6.44
4.50 cents...	4.44	4.62	4.80	4.98	5.17	5.35	5.53	5.72	5.90	6.08	6.26	6.45	6.63
4.75 cents...	4.64	4.82	5.00	5.18	5.37	5.55	5.73	5.92	6.10	6.28	6.46	6.65	6.83
5.00 cents...	4.84	5.02	5.20	5.38	5.57	5.75	5.93	6.12	6.30	6.48	6.66	6.85	7.03

1/ These values were based on the 1952-59 U.S. average yields of 78.3 percent of 44-percent protein soybean meal and 18.3 percent of crude soybean oil.

Table 3.--Value of 100 pounds of soybeans processed as cooked, unextracted meal, based on prices of feed-grade fat and soybean meal, adjusted for caloric value, at specified prices of fat and meal 1/

Price of 44-percent soybean meal, per pound	Price of feed-grade fat, per pound								
	4 cents	5 cents	6 cents	7 cents	8 cents	9 cents	10 cents	11 cents	12 cents
1.50 cents.....	$2.12	$2.35	$2.59	$2.82	$3.06	$3.30	$3.53	$3.77	$4.01
1.75 cents.....	2.32	2.55	2.79	3.02	3.26	3.50	3.73	3.97	4.21
2.00 cents.....	2.52	2.75	2.99	3.22	3.46	3.70	3.93	4.17	4.41
2.25 cents.....	2.71	2.94	3.18	3.41	3.65	3.89	4.12	4.36	4.60
2.50 cents.....	2.91	3.14	3.38	3.61	3.85	4.09	4.32	4.56	4.80
2.75 cents.....	3.10	3.33	3.57	3.80	4.04	4.28	4.51	4.75	4.99
3.00 cents.....	3.30	3.53	3.77	4.00	4.24	4.48	4.71	4.95	5.19
3.25 cents.....	3.49	3.72	3.96	4.19	4.43	4.67	4.90	5.14	5.38
3.50 cents.....	3.69	3.92	4.16	4.39	4.63	4.87	5.10	5.34	5.58
3.75 cents.....	3.89	4.12	4.36	4.59	4.83	5.07	5.30	5.54	5.78
4.00 cents.....	4.08	4.31	4.55	4.78	5.02	5.26	5.49	5.73	5.97
4.25 cents.....	4.28	4.51	4.75	4.98	5.22	5.46	5.69	5.93	6.17
4.50 cents.....	4.47	4.70	4.94	5.17	5.41	5.65	5.88	6.12	6.36
4.75 cents.....	4.67	4.90	5.14	5.37	5.61	5.85	6.08	6.32	6.56
5.00 cents.....	4.87	5.10	5.34	5.57	5.81	6.15	6.28	6.52	6.76

1/ 1952-59 U.S. average yields used were 78.3 percent, 44-percent soybean meal, and 18.3 percent crude soybean oil. The caloric values used were 4,172 calories per pound for crude soybean oil and 3,230 calories per pound for feed-grade fat.

To use table: Find the nearest per pound cost for feed grade fat, including purchase price plus costs for investment in storage facilities, heating, pumping, etc. For example, if feed grade fat costs 5¢/lb. delivered to the mill, and all handling costs are estimated to be 2 cents a pound, then use the 7-cent-a-pound column. If soybean meal (44%) costs 3 cents, then the value of 100 pounds of cooked unextracted meal is $4.00. If local soybeans can be obtained for less than this $4.00 per 100 pounds, the difference is the margin to pay for processing, handling and storage of soybeans used in making cooked unextracted meal.

Table 4.--Value of 100 pounds of soybeans as unextracted meal and as extracted oil and meal at specified prices per pound for crude soybean oil, feed grade fat, and soybean meal (from tables 2 and 3) 1/

Price per pound of 44-percent soybean meal, and kind of soybean product	5 cents per pound	7 cents per pound		9 cents per pound		11 cents per pound		13 cents per pound
	Feed grade fat	Soybean oil	Feed grade fat	Soybean oil	Feed grade fat	Soybean oil	Feed grade fat	Soybean oil
1.5 cents:								
Unextracted meal	$2.35		$2.82		$3.30		$3.77	
Oil and meal		$2.45		$2.82		$3.18		$3.55
2.0 cents:								
Unextracted meal	2.75		3.22		3.70		4.17	
Oil and meal		2.85		3.22		3.58		3.95
2.5 cents:								
Unextracted meal	3.14		3.61		4.09		4.56	
Oil and meal		3.24		3.61		3.97		4.34
3.0 cents:								
Unextracted meal	3.53		4.00		4.48		4.95	
Oil and meal		3.63		4.00		4.36		4.73
3.5 cents:								
Unextracted meal	3.92		4.39		4.87		5.34	
Oil and meal		4.02		4.39		4.75		5.12
4.0 cents:								
Unextracted meal	4.31		4.78		5.26		5.73	
Oil and meal		4.41		4.78		5.14		5.51
4.5 cents:								
Unextracted meal	4.70		5.17		5.56		6.12	
Oil and meal		4.80		5.17		5.53		5.90
5.0 cents:								
Unextracted meal	5.10		5.57		6.15		6.52	
Oil and meal		5.20		5.57		5.93		6.30

1/ Unextracted soybean meal value determined only on the basis of costs of replacing its nutritive protein and energy with 44-percent protein soybean meal and feed-grade fat on an equivalent basis. Extracted oil and meal value based on U.S. average yield for soybeans, 1952-59.

Table 5.--Soybeans: Production, utilization, and farm price, in major broiler areas (excluding Arkansas), 1958

Area	Production (soybeans)	Utilization 1/ (whole bean equiv.)	Utilization as percentage of production	Average farm price per bushel
	1,000 bu.	1,000 bu.	Percent	Dollars
Georgia..........	11,250	11,712	104.1	2.05
Delmarva.........	7,656	7,806	102.0	1.95
North Carolina....	10,212	5,550	54.3	1.95
Alabama..........	2,970	5,376	181.0	2.00
Texas............	1,378	4,297	311.8	1.85
Mississippi.......	18,400	33,318	181.0	1.95
U.S. average price.........	--	--	--	2.08

1/ Amount needed for a typical feed formulation in the broiler industry.

Source: University of Maryland, Competitive Positions of Major Broiler Areas, Series #2, p.6, May 1959.

Table 6.--Transportation rates per ton of soybean meal by the lowest cost means, from major processing or price-basing points to specified broiler producing areas. 1/

Broiler producing area	Decatur, Ill.	Peoria, Ill.	Beardstown, Ill.	Waterloo, Iowa	Atlantic, Iowa
Delmarva...........	$17.00	$17.00	$17.80	$19.60	$21.70
Harrisonburg, Va...	15.70	15.70	15.90	18.30	20.40
Waterville, Maine..	16.70	16.70	16.90	18.30	21.40
Raleigh, N. C......	15.74	12.12	11.95	19.59	19.95
Charlotte, N. C....	13.64	9.82	9.65	17.31	17.67
Durham, N. C.......	14.54	10.92	10.75	18.39	16.75
Memphis, Tenn......	6.02	2.43	2.32	9.98	10.62
Chattanooga, Tenn..	7.85	4.32	4.15	11.81	12.17
Guntersville, Ala..	7.04	4.01	3.84	11.39	11.75
Jasper, Ala........	10.22	6.63	6.52	14.18	13.82
Gainesville, Ga....	10.94	7.32	7.15	14.79	15.15
Forest, Miss.......	10.11	6.53	6.41	14.18	14.71

1/ Various modes of transport to achieve lowest cost routing used in each case.

Source: University of Maryland, Competitive Positions of Major Broiler Areas, Series #2, p. 16a, May 1959.